



Physics Department 2005-2006 Annual Report

June 18, 2006

Part 1: Executive Summary

Over this FY, the Physics Department continues to improve in all missions of the university. The most significant advance, as in the previous year, occurred at the level of the faculty.

Three new members - Drs. Heremans, Park, and Soghomonian - arrived in 2005-6. All bring expertise in the area of condensed matter physics and fit well into the context of university-wide efforts to strengthen nanotechnology and biosciences. Two are female, doubling again the numbers of this underrepresented group in our department *and* bringing the percentage of women physicists at VT well above the national average. Searches in the spring of 2006 resulted in two offers being accepted: one in the cluster of computational sciences and the other in experimental neutrino physics. At the Instructor level, Dr. T.S. Chang has accepted a full time (temporary) position for the coming year. As an award winning instructor, he will bring much needed stability, visibility, and improvements to the education of our undergraduates. With the retirement of Dr. Zallen in January, the department lost one of its most illustrious members. Also in January, at the request of the Chair, the faculty convened to select the successor to Dr. Zia. The result of the election was unambiguous and Dean L.N. Chang subsequently appointed Dr. Schmittmann to be the next Chair. Starting this August (AY 2006-7), she will have the honor of being the first female Chair/Head in the Colleges of Science or Engineering.

In the area of learning, our undergraduate program continues to be rigorous and strong. Though we have a slightly smaller class (13) than the previous year (15), the quality is unmistakable. Of the 12 BS's and one BA, 3 graduated with Summa Cum Laude, and 11 will be pursuing graduate studies. Our valedictorian, David Erickson, maintained a 4.0 GPA and is ranked No. 1 amongst ~5000 graduates this year. A rising senior, Brian Skinner, was the only student from VT this year to be awarded the Barry M. Goldwater Scholarship, following a long tradition that a student in Physics wins this prestigious award. The quality of students in the graduate program is also laudable. Two are NSF Graduate Fellows; three others are NSF IGERT fellows; and one won a national Sigma Xi Award. Though there was only one PhD in this FY, we had 7 MS's and expect a sizable number of graduates during the next FY.

In research, the most prominent change this year is the level of external funding. Slightly over \$1.9M, it represents a 65% increase over the total in the last Annual Report. One laboratory (for neutrino research) has been completed and two others (devoted to

nanoscience) are days from being fully operational. The ranks of postdoctoral research associates/scientists increased markedly, from 11 to 14. The number of graduate and undergraduates engaged in research has also increased substantially, especially in the area of condensed matter physics. Our faculty enjoys considerable national and international reputation, publishing a total of ~70 professional articles and invited to seminars/colloquia, as well as to speak at various national/international workshops, and/or conferences. On the local level, our faculty continues to expand fruitful research collaborations with colleagues all around VT, especially in the strategic areas of nanotechnology and biosciences. These efforts generally lead to the submission of large interdisciplinary proposals. Such efforts are vital, even if the proposals are declined, since they bring considerable expertise and visibility to the department, the college and VT. A excellent recent example is the DUSEL project: Though unsuccessful, Virginia Tech is now a key player in planning the future of neutrino physics.

To engage the public and to join the celebration of 2005 as the UNESCO designated World Year of Physics, our department organized a series of activities. Most notably, there were several public lectures, the last of which occurred in this FY. At a more educational level, our outreach program, which brings physics to K-12 in local schools, continues to thrive. Participating undergraduates usually return to their studies with more enthusiasm and motivation. Finally, development activities have increased slightly this year and the department is fortunate to have a new endowment established - to fund a substantial scholarship for graduate students.

Highlights of our activities are included in this report. Further details and relevant links may be found on <http://www.phys.vt.edu/>.

Part 2: Academic Accomplishments

I. Learning

Undergraduate Program

In general, our undergraduate program is very strong. Most of our graduates who attend graduate schools report that the education they received here placed them in excellent positions to compete with students from other institutions. Those who went into various sectors of the work force report similar experiences.

Our majors appear to be very satisfied with the upper level courses, from the reports in the senior exit interviews and informal feedback through Ms. Diane Walker-Green, our Undergraduate Programs Coordinator. The general quality and the efforts of the faculty teaching these courses are much appreciated. In addition, many of our students are involved with hands-on research with our faculty as well as at other institutions. Further details are provided in a paragraph below. This year's graduates were particularly well prepared for further studies in Physics: ~85% will be attending graduate school next year. In an attempt to meet the changing needs and demands of physics graduates, the Undergraduate Committee is studying modifications to the list of required courses so that new electives (such as biophysics, nanoscience, and computational physics) will be available for students.

The quality of introductory physics courses has been steadily improving, thanks to the efforts of Drs. T.S. "Roger" Chang and Dan Mazilu. The former is an extremely dedicated, award-winning instructor. Once again, Dr. Chang received the "Faculty Appreciation Day Student's Choice Award" from the Student Alumni Association, in 2006. He teaches the first semester course of our calculus-based introductory sequence for physics majors and engineers (PHYS 2305). Dr. Mazilu teaches both semesters of the algebra-based introductory sequence for non-physical science majors (e.g., biology majors), PHYS 2205-2206. To maintain this quality of instruction, Dr. Mazilu was hired during the last reporting period as a full time instructor; Dr. Chang has now been offered a full-time instructor position, and has accepted that offer. One of the goals of the department is to retain both of these dedicated teachers permanently. Indeed, to address the need for quality undergraduate education at the introductory levels across the College of Science, there is a proposal to establish a Center for Science and Math Education, in which dedicated teachers of all disciplines can benefit from each others' experiences, interact fruitfully with experts in education research, and join forces to apply for external funding designated for education.

The Astronomy program continues to be challenged by a shortage of faculty. After the retirement of two faculty members in astronomy in June 2004, there remains *only one* faculty member in astronomy. Dr. Keinigs, has been hired as a part-time instructor to teach the Introductory Astronomy sequence (PHYS 1055-1056). Though a condensed

matter experimentalist by professor, Dr. Heremans (a new faculty member who arrived in December 2005 and had some incidental experience in astronomy) taught Astronomy Laboratory (PHYS 1156) successfully in the Spring semester.

Since the core material in the undergraduate curriculum is largely based on the physics discovered at least a century ago, students are strongly encouraged to participate in the frontline research of today. Many students took advantage of the faculty's offer to advise long term projects. Many also exploit the Research Experience for Undergraduates (REU) programs at other universities. In connection with their research, several students traveled overseas, broadening their perspectives of physics as well as exposing themselves to other cultures. Enabling students to participate directly in international collaborations is surely a contribution to the university's "international mission." Further, these research experiences are crucial to be successful in competitions for national scholarships and fellowships (e.g., Goldwater and NSF), as well as getting admitted to the best of the graduate schools. Details may be found in Part 3 of this report.

The physics department is fortunate to have 16 (mostly endowed) awards and/or scholarships, 11 of which are provided for undergraduates exclusively. In a special Awards Ceremony, 38 students spanning all four classes were honored. The keynote address was given by Dr. Leah Shaw, who received her B.S. in physics and mathematics from Virginia Tech in 1998. Staying an extra year to obtain her M.S. (in mathematics), she wrote a thesis on research with Drs. Schmittmann and Zia. She received her Ph.D. from Cornell University in 2004, and is currently a National Research Council postdoctoral fellow at the Naval Research Laboratory.

Summary data:

- The total number of physics majors is presently 124 (20 women), an increase from last year.
- The number of physics minors is 19 (2 women).
- The number of astronomy minors is 13 (2 women). Many students pursuing an astronomy minor do not declare that minor until they are near graduation.
- Over 30 undergraduate students were involved in research with faculty in the department.
- In May 2006, 13 majors graduated; 3 were Summa Cum Laude, 1 was Magna Cum Laude, and 1 was Cum Laude.
- Eleven of the Class of 2006 will be attending graduate school; 2 will enter the work force.
- The projected graduating class of 2007 is 19 students.
- For Fall 2006, 36 new students have accepted admission to the Physics Department; 28 are new freshmen, 8 are transfer students; 5 of the 36 are women.
- For recruitment purposes, the undergraduate coordinator hosted several Physics Open House events, visited 28 high schools and 12 community colleges in the Virginia, DC, and Maryland areas, and attended the National Black and Hispanic



Class of 2006

Conference in San Jose. Two minority students from Physics attended the conference.

Graduate Program

There were no changes in the core graduate curriculum this past year. General feedback from the students is positive, although there is a general perception that not enough advanced graduate courses are being offered. This situation is due to the low faculty numbers, especially in Astrophysics. If the department achieves the goal of 35-40, it is entirely feasible to increase the total number of PhD students to 70-80. As the condensed matter faculty become more involved in interdisciplinary efforts in biosciences and nanotechnology, there is good reason to believe that this level of growth can be realized in the next 5 years.

The most serious challenge to the graduate program is recruitment, with a consequence being the extreme range of abilities and preparation in the student body. Hopefully, with the influx of new faculty this situation will be addressed in the coming years. Another handicap is that TA duties here are a heavier than the loads students carry at other institutions, as the students have discovered by talking with other students at other institutions (e.g., the University of Tennessee was mentioned several times).

The department was fortunate that an additional scholarship – the William E. Hassinger Graduate Fellowship – was established in the spring of 2006. This brings the total number of awards/scholarships designed for graduate students to five. In a special Awards Ceremony, 5 graduate students received awards.

Summary data:

- The total graduate enrollment in physics stands at 46 (9 women, 1 minority)
- There are 37 students in the PhD program
- One student is at the NVC (working full-time at the US Patent Office), actively conducting research towards her doctoral thesis.
- One student received his Ph.D. He has accepted a postdoctoral position.
- One student will be receiving the Ph.D. later this summer, and another will be defending in the Fall of 2006.
- Seven students obtained the M.S. degree (three in the Applied & Industrial Physics Program).
- At present, there are 14 postdoctoral research personnel working with faculty in the department. While their main focus is research, some occasionally teach a course, or help with graduate and undergraduate students in research. In this manner they are mentored in making a smooth transition from being a graduate student to faculty member.

II. Discovery

For a bird's-eye view of the research programs in Physics, it is convenient to use two main categories: condensed matter and particle/astrophysics. In each, faculty expertise typically lies in either experimental or theoretical approaches. Roughly speaking, a quarter of the faculty engages in research in each of these sectors. Apart from their own programs, the condensed matter physicists share interests with many scientists in a variety of other departments at Virginia Tech. Every member of this group is involved in some form of interdisciplinary research, ranging from nanotechnology to biosciences. In contrast, the research in particle/astrophysics typically takes faculty far away from campus. Since the experimental devices needed for this frontier are so gigantic that only international collaborative efforts can succeed. As a result, our faculty, research associates, and students working in this area travel frequently to distant locations: Brookhaven (NY), Los Alamos (NM), Newport News (VA), Gran Sasso (Italy), Pisgah Astronomical Research Institute (NC), and Tsukuba (Japan). These successful programs project an image of the department far beyond Blacksburg or Virginia.

There are other standard measures of success, of course. One is external funding, which increased substantially over the previous year. The total in this FY is, to date, close to \$2M. A listing of the details may be found in Part 3. Publications in refereed journals and conference proceedings, as well as invited presentations at national/international conferences or workshops, are other measures. Finally, a gauge for the reputation of an institution is the willingness of professionals, with their *own* support, to spend extended periods of time working there. In this sense, the Physics department is proud to host such visiting scientists.

- Since references to publications are by calendar year, it is non-trivial to provide a precise count of those published in a fiscal year. Thus, 67 journal-articles/book-chapters/invited-proceedings were published in 2005 while many have appeared in 2006.
- Books:
 - Dr. Minic's book *In Search of Another Miraculous Year --- From 1905, Einstein's Annus Mirabilis, to the frontiers of 21st century physics* was published in October 2005, in Serbian, by DNCentar.
 - Dr. Takeuchi's book *No Equations! Relativity Illustrated* was published in September 2005, in Japanese, by Iwanami Shoten.
- Research Highlights:
 - A significant breakthrough in Quantum Chromo-Dynamics, in the form of exact solutions in the pure gauge sector, was accomplished by Drs. Minic and Yelnikov, along with their collaborator at UIUC. The paper, entitled *Solving Pure Yang-Mills Theory in 2+1 Dimensions* was published in *Phys. Rev. Lett.*
 - A potentially important development, concerning a new type of neutrino reaction involving *recoilless* neutrinos, was reported by Dr. Raghavan. Promising to increase detection rates of this illusive particle by "ten orders of magnitude," it supposedly captured the attention of the specialists world-wide.

- Another article in a series on *Factorised steady states in mass transport models*, published in the *Journal of Physics A* by Dr. Zia and his collaborators in Edinburgh and Paris, was chosen be part of IOP Select, a special collection deemed to have “substantial advances or significant breakthroughs.”
- *Invited* talks at national/international conferences/workshops/schools:
 - Dr. Heflin: NSF US-China Nanotechnology Workshop
 - Dr. Minic: Workshop on *Beyond the Standard Model* (William and Mary), Conference on *Fundamental Physics* (Coral Gables) and lecture at a European Summer school in Serbia
 - Dr. Park: American Physical Society March Meeting (an honor usually bestowed on senior scientists)
 - Dr. Raghavan: Workshops on underground neutrino physics at Seattle and Sudbury (Canada); international conferences held in Spain and Honolulu.
 - Dr. Schmittmann: Conference entitled *Renormalization Group2005* (Helsinki, Finland).
 - Dr. Takeuchi: a series of lectures on *Relativity* and *Quantum Mechanics* at the Ochanomizu Women’s University (Tokyo, Japan)
 - Dr. Täuber: a series of lectures at four separate events: International Summer School in Luxembourg, a Workshop on *Applications of Methods of Stochastic Systems and Statistical Physics in Biology* at Notre Dame, the Arnold Sommerfeld Center for Theoretical Physics (Munich, Germany), and a Workshop on *Non-Equilibrium Dynamics of Interacting Particle Systems* at the Isaac Newton Institute for Mathematical Sciences (Cambridge, U.K.). Dr. Tauber was also invited to write two extensive reviews on the application of field theory approach to percolation and reaction diffusion processes, both appeared in 2005.
 - Dr. Vogelaar: Particles and Nuclei International Conference (PANIC 2005).
 - Dr. Zia: Workshop on *Brownian Motion: A Paradigm of Soft Matter and Biological Physics*, the Arnold Sommerfeld Center for Theoretical Physics (Munich, Germany).
- Visiting Scientists:
 - Prof. H.W. Diehl of University of Duisburg-Essen (Germany) spent part of his sabbatical in the department and completed the manuscript on *Boundary critical behaviour at m-axial Lifshitz points* (posted on cond-mat/0512681) here.
 - Dr. G. Püssner, as research associate from UK and Germany, was funded by the Feodor Lynen program of the Alexander von Humboldt Foundation (Germany).
- Dr. Raghavan’s LENS (Low Energy solar Neutrino Spectrum) laboratory was completed recently.
- Drs. Heremans and Soghomonian moved their entire laboratory, consisting of ~\$300K of equipment, from Ohio University in the Fall. Their laboratory, devoted to the study of electronic and magnetic properties nanostructures, is on the verge of being fully operational.

- Joining forces with Drs. Ellington and Patterson of the Electrical and Computer Engineering Department, Dr. Simonetti works with the Eight-meter-wavelength Transient Array (ETA) to monitor intense bursts of radiation from a variety of astronomical objects (e.g., primordial blackholes and supernovae). The ETA is a member of a new generation of arrays, leading the way toward future systems such as the Square Kilometer Array.

III. Engagement

The physics department is committed to reaching out beyond the campus, with a variety of events designed for the non-experts.

- UNESCO's World Year of Physics 2005 celebration continued during this reporting period, with Dr. Raghavan giving a public lecture on the inner workings of the Sun ("How Does the Sun Shine?").
- In addition to appearing frequently on local network TV, Dr. Simonetti was featured in the regional radio program "With Good Reason." Dr. Simonetti spoke on a variety of topics, e.g., Einstein and 1905, the World Year of Physics, Special and General Relativity, and cosmology.
- Dr. Simonetti's Frequently Asked Questions about Physics and Astronomy website continues to acquire the largest number of "hits" of any webpage produced by the department. He also continues to maintain the Sky Image Processor. A web-based astronomical image processing and analysis system, it enjoys usage from a wide range of institutions around the world.
- The departmental web pages, currently maintained by Dr. Takeuchi, with assistance from Dr. Zia and Ms. Betty Wilkins, are much improved. Containing not only essential information, the photo gallery of research activities and social functions won much praise from many alumni, parents, perspective students, and friends.
- In January of 2006 the Quanta newsletter was produced in a pdf format and placed on line. Around Christmas, a simple letter was written to over 1000 alumni, providing them with the URL. Hard copies were sent to those who are less familiar with the web.
- Many of the undergraduate physics majors took part in an outreach program, conducted by the department, visiting local and regional K-12 classes/student groups and giving informative and entertaining physics presentations and demonstrations. This program was coordinated by Matt Joyce, a graduate student in Physics.
- Dr. Khodaparast presented a lecture at the Roanoke Valley Governor's School for Science and Technology.
- Two important annual events are the Awards Ceremony and Commencement. In both,



Bringing Physics to Belair Elementary



parents/family/friends of the students form a significant component of the participants. Benefactors were also invited to the Awards Ceremony. These events showcase the best in our department. This year, Ms. Betty Wilkins designed and produced the programs.



Dr. Zallen's exhibit of line drawings and illustrations, entitled *The Aesthetics of Physics: Patterns from the Physics of Solids*, displayed at the Wallace Hall Gallery, January 17 to February 3, 2006.

IV. Diversity Activities

- With the arrival of Drs. Kyungwha Park and Victoria Soghomonian in August and December respectively, the number of women faculty in Physics doubled again in 2005. The total is now 4, so that the fraction of women faculty in the department is $4/23$, which is over twice the national average (approximately 7% according to the American Institute of Physics statistics) for physics departments in PhD granting institutions in the US.
- The “Ladies of Robeson” is an informal group first established by a few female physics majors three years ago. Under the energetic leadership of Ms. Annalisa Pawlosky, a graduating senior, this group blossomed. Specifically, the number of events and significant activities increased dramatically. For example, the group hosted several meetings/socials with both female faculty from other physics departments and recent alumae, so as to encourage women students to continue in physics and to facilitate with their career paths. In view of the high drop-out rates of women physics students, this group has served well as a support system and a means of retention. A further goal is to establish a scholarship fund to encourage women who choose to pursue a career in physics.
- Funded by a \$3.5M NSF grant, the *AdvanceVT* program is designed to facilitate “institutional transformation” at Virginia Tech and to enhance the advancement of women in academic science and engineering careers. As one of four Advance Professors, Dr. Schmittmann continues to play a key role in this program. More recently, Dr. Soghomonian joined the Leadership Development Program, in preparation for future leadership roles.



“Ladies of Robeson” at a recent pot-luck dinner in Dr. Schmittmann’s

- In an effort to recruit minority students to Virginia Tech, Ms. Diane Walker-Green, the Undergraduate Programs Coordinator, attended the National Black and Hispanic Conference in San Jose. Two minority students from Physics also attended the conference.

V. Service

Members of the physics faculty contribute invaluable service to the department, the college and the university in variety of ways. In addition, they fulfill professional duties through refereeing articles for journals, as well as reviewing proposals and serving on panels for funding agencies.

- Faculty members serve on one or more departmental committees. Departmental committees include standing committees: the Executive Committee, Faculty Evaluation Committee, Graduate Ph.D. Committee, Graduate M.S. Committee, Graduate Recruitment Committee, Undergraduate Committee, Undergraduate Advising & Awards Committee, Shop and Safety Committee, Colloquium Committee, and the Seminar Committee. In addition, there are ad-hoc committees: Outreach (K-12) Committee, Undergraduate Research Committee, Cluster Hire Search/Screening Committee, and the WYP2005 Planning Committee.
- Faculty members also serve in other capacities, individually: Astronomy Club Advisor (Dr. Simonetti), Demonstrations Supervisor (Dr. Pitt), Diversity Contact (Dr. Ritter), Martin Observatory Coordinator (Dr. Simonetti), Lab coordinator for ChemPhys Building (Dr. Pitt), Prices Fork Observatory Coordinator (Dr. Simonetti), Publicity (Dr. Zallen), Society of Physics Students Advisor (Dr. Soghomonian), Sigma Pi Sigma Advisor (Dr. Pitt), Webmasters (Dr. Takeuchi, with assistance from Ms. Betty Wilkins and Dr. Zia).
- Dr. Heflin served on the Institute of Critical Technology and Applied Science Director Search Committee.
- Dr. Khodaparast was a member of the College of Science Dean's Search Committee, Office of the Provost.
- Dr. Kulkarni served on the Biological Sciences Faculty Search Committee and on a committee to explore collaborative efforts between Georgetown and Virginia Tech in biophysics.
- Dr. Piilonen served as Chair of the College of Science Curriculum Committee.
- Dr. Piilonen served as a reviewer for the College of Science Scholarship Committee.
- Dr. Raghavan served as the Director of the Institute for Particle Physics and Astrophysics (recently renamed the Institute for Particle, Nuclear, and Astronomical Sciences). Dr. Takeuchi served as its Associate Director.
- Dr. Ritter served as a committee member for the Office of Sponsored Research to select proposals for submission to a Materials Research Initiative.

- Drs. Schmittmann and Heflin served in the Executive (“Core”, “Cluster”) Search Committee, College of Science.
- Drs. Schmittmann and Piilonen served on the Personnel Committee, College of Science.
- Dr. Schmittmann served on several key committees for Office of the Provost: the leadership team of *AdvanceVT*, the University Academic Advisory Committee (reviews the University Strategic Plan), and the College of Science Dean’s Search Committee.
- Dr. Schmittmann played a major role in selecting nominees for national scholarships for the Honors Program: the Campus Marshall/Rhodes Scholar Selection Committee and the Goldwater Scholar Selection Committee.
- Dr. Vogelaar is the Physics representative on VT Faculty Senate.
- Dr. Zia serves on the Advisory Boards of *AdvanceVT* and EIGER (*Exploring Interfaces through Graduate Education and Research*, an NSF-IGERT grant administered through the department of Geological Sciences).
- Many faculty members served as reviewers for professional journals and funding agencies.
- Various faculty members are members of the editorial boards of *International Journal of Modern Physics*, *International Journal of Nanoscience*, *Journal of Modern Optics*, *Journal of Optics A*, *Journal of Physics A*, *Journal of Smart Materials*, *Journal of Statistical Physics*, *Modern Physics Letters*, *Optik*, and *Physical Review E*.

VI. Honors and Awards

At all levels, members of the physics department have been honored in a multitude of ways. Following are the highlights.

Faculty

- Dr. T.S. Chang received the “Faculty Appreciation Day Student's Choice Award” from the Student Alumni Association, in 2006. He was also nominated the National Society of Collegiate Scholars' 2006 Faculty of the Year Award.
- Dr. Minic received the University of Illinois at Urbana-Champaign Research Board Award.
- Five professors were honored as Virginia Tech Scholar of the Week:
 - Dr. Pitt, May 30, 2005 - June 5, 2005
 - Dr. Schmittmann, Nov. 28, 2005 - Dec.4, 2005
 - Dr. Piilonen, Feb. 6, 2006 - Feb. 12, 2006
 - Dr. Blecher, April 10-16, 2006
 - Dr. Simonetti, May 8-14, 2006

Graduate Students

- Four departmental awards/scholarships were presented to 5 graduate students.
- Three graduate students were inducted into Sigma Pi Sigma, a national honor society for Physics Students, at a banquet attended by faculty, staff, parents, and family members. Dr. Takeuchi gave an entertaining speech about the physics of color.
- Debabrata Mohapatra received a Sigma Xi Award for Achievement in Research by a Ph.D. Candidate.
- Juliette Mammei awarded SURA/Jefferson Lab Graduate Fellowship for 2006/2007 academic year.

Undergraduate Students

- Brian Skinner received the Barry M. Goldwater Scholarship. This Scholarship is awarded after a nationwide competition amongst “sophomores and juniors who intend to pursue careers in mathematics, engineering or the natural sciences.” Brian is a rising senior, majoring in physics and in mechanical engineering, with minors in mathematics and Spanish. This year, Brian was the only Virginia Tech student to win this award, being the 33rd student to win this prestigious scholarship since its inception in 1986. Brian has been conducting research with Drs. Beate Schmittmann, Bruce Vogelaar, and Royce Zia.
- Brian Skinner received the College of Science’s Robert T. Lawson and John R. Lawson Scholarship.
- David Erickson, the valedictorian this year, was triply honored by Phi Kappa Phi. With a perfect 4.0GPA, he won the Medallion award. Selected by the VT chapter as one of two graduating seniors with the greatest potential for future scholarly contributions, he was presented the chapter’s Scholarship Award. Finally, he was nominated by the VT Chapter to the national Phi Kappa Phi organization for, and subsequently won, a Graduate Fellowship. David had been a Barry M. Goldwater since 2004.
- Juilan McMorrow received the College of Science’s New Freshman Scholarship.
- Kevin Finelli received the College of Science’s New Freshman Scholarship.
- James Dowd received the College of Science’s Robert C. Bates Scholarship.
- Sean Settle received the College of Science’s David and Ruth Henderson Scholarship.
- Annalisa Pawlosky, was awarded an Society of Physics Students Leadership Scholarship by the National SPS office.
- Ten departmental awards/scholarships were presented to 38 undergraduate students.
- Eight students were inducted into Sigma Pi Sigma, a national honor society for Physics Students, in the same banquet held for the induction of graduate students.

Staff

- Cindy Davis received a 20 year Service Award from the College of Science.
- Chris Thomas received a 30 year Service Award from the College of Science.
- Melvin Shaver received a 40 year Service Award from the College of Science.

VII. Future directions

Over the last two years, the physics department has begun to recover from the major losses in faculty ranks during the 90's. There is hope that this trend will continue and the effort to bring this department up to the level of major research universities will be successful in the not-too-distant future. With the imminent generational change of leadership, there is considerable optimism that a more vibrant department will emerge. With sights on new heights and horizons, it should find itself playing leadership roles in the local VT setting as well as the global scientific community.

The expertise of all three new faculty members who joined the department in the last AY (FY) is in condensed matter physics, an area particularly suited for interdisciplinary research. Thus, the department is in a much better position to be a key player in the university-wide drive towards eminence in nanotechnology and biosciences. The efforts in last FY to bring a national laboratory (DUSEL) to VT, though unsuccessful, provided an opportunity to develop much needed know-how for organizing similar efforts. In particular, Dr. Heflin's experience with submitting proposals for large interdisciplinary grants should dovetail well with that of Drs. Heremans and Soghomonian, who established a center for nanoscience at Ohio University in recent years. Hopefully, the physics department will soon find itself in the lead role of one of these multimillion-dollar enterprises.

During this year, the search for new hires in computational nanoscience resulted in one new hire: Dr. Michel Pleimling, at the level of Associate Professor without tenure. Honoring our commitment to expand the effort in neutrino physics, a search for that junior faculty resulted in our hiring Dr. Jonathan Link as an Assistant Professor. The future plan is to continue strengthening condensed matter physics, as well as to revitalize other core areas such as astronomy/astrophysics. In particular, future hires to enhance the collaboration with the many departments in biosciences on campus will be beneficial. It is equally important to preserve disciplines in the "heart of physics," by replenishing recent losses in those areas. For a physics department to sustain a vital research program and an international reputation, it is essential to maintain a healthy balance between dollar-driven and "curiosity driven" research. Extending the frontiers of knowledge is just as crucial as "putting knowledge to work" for a keystone discipline like Physics.

While the undergraduate program is strong, both the quality and quantity of the majors can be improved. One hope is that more resources can be found to send not just Ms. Walker-Green, but also our faculty, on recruitment trips to schools in the region, especially those with strength in science and technology. To meet changing demands on

our students, the department is planning to collaborate with Biological Sciences to establish a robust program in the emerging field of biophysics. Similarly, there are plans to take full advantage of the newly established partnership with the Law School of University of Richmond so that a student will graduate in 6 years with both a BS in Physics and a JD degree, specializing in intellectual property law.

Though there are peaks of excellence in the graduate program, it needs strengthening in several areas. The overall quality of the incoming students can be improved. Again, the need for a vigorous recruitment program cannot be overemphasized. Both active (sending faculty on recruitment trips) and passive (inviting the best applicants to visit) activities require serious financial support. Recently, Dr. Khodaparast spearheaded an initiative to site a NSF-REU program in Physics. If successful, it will increase our visibility significantly. Lastly, one of the best incentives for students to attend a certain school is the availability of graduate research fellowships. Financial support to increase these numbers substantially should be sought. Turning to the curriculum, at present, only the core courses are offered regularly. The deficiency of 6000 level courses will hopefully be remedied as the faculty numbers increase. A strong physics department can hardly exist without a strong graduate program. In partnership with the Graduate School, the strengthening of this program will be one of the highest priorities.

While research and graduate education is the dominant focus of this university, the critical mission of educating the younger generation should not be sidelined. Indeed, there is increasing national awareness that an urgent need to improve science and math education in this country persists. In this respect, the physics department is highly motivated to bring dedicated teachers and education-researchers into our ranks. Specifically, finding permanent positions for award winning teachers like Dr. T.S. Chang is a priority. The possibility of renovating the departmental “library” into an area dedicated to the teaching mission - with offices for the instructors and lab-demo developer, as well as space for individual tutorials - is being pursued vigorously. Beyond Robeson Hall, there is a vision to join forces with other departments in the college to form a Center for Science and Math Education. Further, participation in a university-wide initiative to establish programs in STEM is expected to continue.

One essential future direction is to increase development activities. Fortunately, a number of faculty members are aware of the importance of this activity and are beginning to participate. The targeted areas are scholarships for graduate students, departmental postdoctoral fellowships, endowed chairs for junior faculty, support for a distinguished lecture series and/or symposia and workshops, as well as funding for research activities in general.

Finally, in the context of departmental reviews within the College of Science, Physics is scheduled for one in 2007-2008. Since the last review occurred over ten years ago, this activity is long overdue. Indeed, many facets of the department have changed a great deal over the last decade. So has the environment in which it finds itself, from the local academic to the wider global setting. With the help of such a review, it can position itself strategically to take full advantage of swiftly evolving boundary conditions.

Part 3: Additional Information

Grants received

Externally funded grants since July 1, 2005:
(Data mostly provided by the College of Science.)

Investigator	FRS	Amount	Agency
Blecher, Marvin	477503	\$80,000	NSF
Heflin, James R.	415267	\$50,000	Luna
Heflin, James R.	430200	\$49,000	Army
Heflin, James R.	455117	\$45,000	U. Alberta
Heflin, James R.	477378	\$42,243	NSF
Heflin, James R.	477378	\$37,757	NSF
Heflin, James R.	477489	\$22,500	NSF
Heflin, James R.	477515	\$20,485	NSF
Heflin, James R.	477515	\$5,918	NSF
Heflin, James R.	477516	\$10,745	NSF
Heflin, James R.	477516	\$4,256	NSF
Heremans, Jean J.	477477	\$137,768	NSF
Khodaparast, Giti	443973	\$10,000	Jeffress
Khodaparast, Giti	477365	\$207,000	NSF
Kulkarni, Rahul V.	443971	\$10,000	Jeffress
Minic, Djordje	429136	\$63,500	DoE
Morgan, Norman K.	477345	\$23,500	NSF
Park, Kyungwha	443010	\$30,000	Jeffress
Piilonen, Leo E.	429151	\$180,000	DoE
Pitt, Mark L.	477143	\$38,532	NSF
Pitt, Mark L.	477345	\$70,500	NSF
Raghavan, Ramaswamy	477355	\$81,000	NSF
Robinson, Hans	443028	\$25,000	Jeffress
Schmittmann, Beate	477165	\$92,500	NSF
Simonetti, John H.	477358	\$134,389	NSF
Takeuchi, Tatsu	429136	\$63,500	DoE
Vogelaar, Robert B.	430031	\$10,000	NRL
Vogelaar, Robert B.	477143	\$89,907	NSF
Vogelaar, Robert B.	477355	\$189,000	NSF
Zia, Royce K P.	477165	\$92,500	NSF

In addition, the following faculty members are involved in major efforts which benefit the research efforts of the department.

- Dr. Indebetouw is Co-PI on an NSF-MRI grant administered from Johns Hopkins University, at ~\$1M for 3 years. This project is the *raison d'être* for his Study Research Leave at JHU in 2005-6.
- Drs. Schmittmann, Heflin, and Kulkarni are part of an IGERT grant, entitled *EIGER - Exploring Interfaces through Graduate Education and Research*. Administered from Geological Sciences, it is funded at ~\$3M for 5 years and provides fellowships for 3 graduate students in Physics.

New Faculty Hires

- Dr. Kyungwha Park, Assistant Professor (August 2005)
- Dr. Jean Heremans, Associate Professor (December 2005)
- Dr. Victoria Soghomonian, Associate Professor (December 2005)
- 6 postdoctoral research associates
- Offers made in this FY and accepted:
 - Dr. T.S. “Roger” Chang, Full-Time Instructor
 - Dr. Jonathan Link, Assistant Professor
 - Dr. Michel Pleimling, Associate Professor

Faculty Promotions and Retirements

- Dr. Randy Heflin was promoted to the rank of Full Professor
- Dr. Uwe Täuber was promoted to the rank of Full Professor
- Dr. Richard Zallen was appointed Professor Emeritus

New Staff Hires and Retirements

- There was one significant change at the staff level. Ms. Betty Wilkins joined the department in November of 2005 charged with program and academic support with an emphasis on web documentation and building alumni relations.
- Mr. Melvin Shaver, the supervisor of our machine shop, will retire at the end of June. This position is currently being advertised and interviews are expected to take place shortly.
- The position for a technician to assist in undergraduate laboratories and development of lecture demonstrations will be advertised shortly. This position has been vacant for over a year. The duties were performed by Mr. Clark Snelgrove, a Research Scientist on a temporary appointment.

Undergraduate Research

- Partial list of undergraduate students involved in research in Physics:
 - Samir Abboud
 - David Adams
 - Geoff Adams
 - Michael Avery
 - Colin Beal
 - Anna Belak
 - Elizabeth Bonnell
 - Aaron Burger
 - George Daquilla
 - Daniel Davis
 - James Dowd
 - David Erickson
 - Kevin Finelli
 - Richard Foster
 - Jessica Gorzo
 - Kristen Hendershot
 - Jonathan Hughes
 - Christopher “Ryan” Luck
 - Julian McMorrow
 - Reza Montazami
 - Brandon Nipper
 - Annalisa Pawlosky
 - Brian Skinner
 - Brett Spencer
 - Nicole Spencer
 - Stuart Strommen
 - Laura Triplett
 - Emily Wade
 - Mark Washenberger
- Some details (further links on <http://www.phys.vt.edu/undergradresearch.html>):
 - Sam Abboud, Physics '07, Richard Foster, Physics '06, and Kevin Finelli, Physics '09, have worked with Mark Pitt on hardware and software projects for two high energy electron scattering experiments - G-ZERO and with Qweak.
 - David Adams, Physics and Computer Science '07, studied domain growth in biased diffusion of two species with Beate Schmittmann (NSF-DMR-0414122). Currently, he is working on the power spectrum of the totally asymmetric simple exclusion process and the application of this lattice model to protein synthesis in an environment of limited resources.
 - Geoff Adams, Physics and Biology '06, carried out Monte Carlo simulations to study population dynamics models with Uwe Täuber (NSF DMR-0308548).
 - Anna Belak, Physics '08, has embarked on a project with Vicki Soghomonian to capture AFM (atomic force microscopy) images of various DNA molecules on different surfaces.
 - George Daquila, Physics '06, is working with Uwe Täuber on numerical simulations for driven magnetic flux lines in superconductors with tilted columnar defects (NSF DMR-0308548).
 - David Erickson, Physics and Mathematics '06, is investigating phase transitions in non-equilibrium statistical mechanical systems with Beate Schmittmann and Royce Zia, carrying out Monte Carlo studies for a model for "traffic across a narrow bridge" (NSF-DMR-0414122).
 - Richard Foster, Physics '06, contributed to the development of a holographic scanning microscope with Guy Indebetouw, carrying out studies for the digital

reconstruction of micro-holograms. Publication of this research has been accepted by the Journal of Optical Soc. Am.

- Christopher "Ryan" Luck, Physics '06, continues to work with Louis Guido on Gallium Nitride characterization.
- Julian McMorrow, Physics '09, is working with Hans Robinson on the fabrication of metallic nanostructures for surface plasmon enhancement of non-linear optical effects in polymer films.
- With Beate Schmittmann, Brian Skinner, Physics and Mechanical Engineering '06, is modeling host-parasite population dynamics in the context of non-equilibrium statistical mechanicals (NSF-DMR-0414122). He also works with Bruce Vogelaar on pulsed laser deposition for the Ultra Cold Neutron experiment in Los Alamos.
- Devon Triplett, Physics '07, is helping Hans Robinson with the assembly and validation of an ultra low temperature adiabatic demagnetization cryostat.
- Emily Wade, Physics '08 and Brett Spencer, Physics '07 are setting up an ultrafast laser spectroscopy laboratory with Giti Khodaparast and her graduate students.
- Eric Ward, Physics '07, will join Jean Heremans and Vicki Soghomonian, performing charge transport experiments on molecular and organic systems, and developing measurement procedures for these systems and for nanoscale electronic applications.
- Mark J. Washenberger, Physics and Computer Science '06, continues to work with Uwe Täuber on Monte Carlo simulations for diffusion-limited chemical reactions and population dynamics models (NSF DMR-0075725/0308548, Jeffress Memorial Trust). This research was published in Journal of Physics and a new e-journal: JSTAT.

Students participating in REU programs at other institutions include:

- David Erickson, Physics '06, studied the Cryogenic Leidenfrost Effect while participating in an NSF REU at UCLA (summer 2005). In summer 2006, he is in the LARSS program of NASA, Langley.
- Christopher "Ryan" Luck, Physics '07, worked on Gallium Nitride growth in the Center for Materials Research REU program at Cornell (summer 2004).
- Annalisa Pawlosky, Physics '06, participated in a Summer Internship Program at the Center for Materials Science and Engineering at MIT (summer 2004) and worked in the group of Dr. Ingo Koeper at the Max-Planck Institute in Mainz Germany (summer 2005).
- In summer 2006, Sean Settle, Physics, Chemistry, and Mathematics '06, will be working with Dr. Duanpen Lertpibulpanya at the Chulabhorn Research Institute in Bangkok, Thailand, performing total and asymmetric synthesis of isoquinoline and benzazepine alkaloids for pharmacological purposes (NSF CHE-0453126).
- Brian Skinner, Physics '07, worked with Dr. David Cory's quantum computing group as part of a summer internship at the Center for Materials Science and Engineering at MIT (summer 2005). He is presently working at CERN, Geneva, Switzerland.